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ABSTRACT

The use of elementary science magazines to generate interest and provide resources for scientific information other than chemistry is discussed. Several examples are provided of ways in which "Science World" and other magazines can be used to generate material of interest to college students. (CS)

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SIMPLE TECHNIQUES TO GENERATE CHEMICAL APPLICATIONS THAT AROUSE STUDENT INTEREST*

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Until about 1970, there were more students who wanted to go to college than there were vacancies available. Today, this is no longer true. A major problem facing colleges is not just attracting students but retaining the students they have already enrolled.

It is believed by some that a greater retention of students will occur if students feel better about their learning process. There are certain variables that students believe have a positive effect on their learning or, at least, on the way they feel about their learning experience.

Students feel that it is very important for them to recognize how a particular course fits into their career, their vocational growth, and their personal growth. Somehow, a sense of relevancy must be built into the course structure.

The blending of chemistry with a variety of current applications tends to accomplish this goal. It places both chemistry and student into a familiar setting; it stimulates student interest; it produces an educated versus a trained student. Applications are more interesting to learn (and more fun to teach) than a collection of facts and theories isolated from the surrounding world.

I have accidently discovered a simple technique. This

*Presented at the 1981 American Chemical Society National Meeting, New York City.

technique has generated a wealth of applications for use in my classrooms; it has resulted in the publication of my book, and it has been responsible for opening the door to my present position as feature editor with the Journal of Chemical Education.

I would like to give you the rationale behind this simple technique before I explain the technique. My rational involves a review of ideas with which you are probably familiar.

We are living in an age of increasing specialization. The so called information explosion has produced a corresponding ignorance explosion, for, as we specialize more about narrower aspects of chemistry, we suffer in a broader sense. Just as an obstetrician would not think of substituting for a neurosurgeon during an operation, the majority of chemists are not only ignorant of many areas of chemistry (and understandably so) but they are also ignorant of many areas of science outside of chemistry (such as physics, biology, astronomy, geology, and computer science). How many chemists could do well in even a high school final examination in these various areas?

Very few chemists have ever heard of the publication Science World. It's a junior high school magazine put out by Scholastic Magazines. I first discovered Science World when my wife, Mary, brought home an issue that she had come across at the junior high school where she was teaching. This was about 15 years ago. At that time I had never had a biology course, a physics course, or a geology course, and I found the articles in these areas fascinating and educational. I discussed some of

the chemistry related articles with Ph.D. chemists who proved to be as ignorant as I and equally as fascinated.

After I graduated and began teaching, I continued to read Science World and, after about three years, introduced material from a Science World article on circadian rhythm (the so called biological clock within all living organisms) to my general chemistry class. The lecture was more successful than I ever dreamed it could be.

I am suggesting, as a first step in the technique of generating material of interest to your students, subscribing to and reading elementary science periodicals such as Science World. This sounds like such a simple idea that I'm almost embarrassed to submit it to you. However, I'm not aware of anybody else doing this. I discovered this by accident and it has worked for me. I would not be surprised if you are sceptical because even my best friends have taken this advice politely, only to confess years later that they have rediscovered it on their own.

These elementary periodicals have one goal: to try to arouse an interest in science in a population that is relatively uninterested. Many grade school and junior high school students could care less about science. The articles in these magazines must be interesting as well as accurate.

Recently, a whole glut of new science magazines has hit the market, most of which are aimed at the nonscientist or non-chemist. For example, there's Discover, Sciquest, Science News, Science81, and Next. Other similar sources include the science

section of Time, Consumer Reports, and the Secondary School Section of the Journal of Chemical Education. Most of these magazines have highly condensed sections for economy of time, e.g., Shorts, Notes, Capsules, Concentrates, News in Brief, Newscripts, Currents, Up Front, Flotsam and Jetsam, Department of Obscure Information, and Notes From All Over.

There is a practicality involved with the elementary periodicals. It's easy to tell what their articles are about by reading the titles in the table of contents. I have always been facinated with dinosaurs but could have easily missed a recent article in Science entitled, "Extraterrestrial Cause for the Cretaceous-Tertiary Extinction, Experimental Results and Theoretical Interpretations." When Science World covered the same story, they gave it the following title: "Were the Dinosaurs Zapped by an Asteroid?"

When it came time for me to prepare a table for my publishing company to indicate the sources of the ideas used in my book, I noticed that 25% of the references were from Science World. To its credit, 50% of the references were from the Journal of Chemical Education. The other 25% were equally distributed among the periodicals I have already mentioned and some others which I hesitate to mention ... such as Playboy.

After you have found an elementary science periodical, you are very likely to come across an article or two that really excites you, or that you think will really be of interest to your chemistry students. Fit the information found in this

article into your lectures. As chemistry teachers who teach general chemistry, you are blessed with a survey course that covers so many different topics that almost anything you read can be related to one of the vast number of topics covered in a general chemistry course.

There are many ways in which new information can be inserted into your existing lecture notes. The trick is to insert this material without using up too much time since the lack of time is a major problem for most of us anyhow. We already have too much material to cover and not enough time in which to cover that material.

One way to insert interesting applications into a lecture without consuming valuable time is to use the applications in example problems. Many of the example problems we use deal with nonexistant artifacts and immaginary data. In place of the nonexistant artifacts substitute real artifacts. In place of the immaginary data substitute real data. For example, I have found that the Shroud of Turin is of interest to most of my students regardless of their religious or nonreligious inclinations. (The Shroud of Turin is a 14-foot linen cloth that bears the image of a crucified man. Some people claim that the shroud is the burial cloth of Jesus Christ.) It is easy to calculate what the carbon-14 radioactivity of the cloth must be in counts per minute per gram of carbon if the cloth is actually 2000 years old. This calculation can substitute for one of the similar radiocarbon examples that you are probably already using.

There are many interesting ideas even in nonscientific periodicals that can be used to arouse the interest of students. The Reader's Digest recently published an article that discussed the meanings of little-known words of the English language. One of the words was the word "berm". What is a berm? If you dig a hole, you usually place the dirt you dig from the hole into a pile next to the hole. The space between the pile of dirt and the edge of the hole is the berm. Really! Instead of asking your class to convert ten inches into centimeters, why not ask them to express the length of a ten inch berm in centimeters?

Admitedly, you will frequently have to do some additional digging, because many of these articles are not very specific or scientifically detailed. This will force you to seek out, for example, a specialist or specialty text for greater amplification. This can be fun as well as educational.

To illustrate, I read what I considered an interesting article in a magazine called Next about a professor of architecture at the University of Texas who figured out a way to grow buildings and other "concere" strucures underwater. The resulting structures had the same color and texture of concrete, were at least 30% stronger than concrete, and were 1000 times cheaper than concrete. The material "grown" is primarily magnesium hydroxide and is formed by making cathodes out of metal mesh in the form of the desired strucutre. Electrolysis makes minerals in the seawater adhere to the mesh.

Now, I know that cathodes attract cations and cause them to plate out of solution, but I was perplexed as to how it was possible to plate out of solution a salt such as masnesium hydroxide. It was a real puzzle for a while, and it was only upon discussing this puzzle with other instructors that the mechanism for this process became clear. (The mechanism was not explained in the original article since the article was not aimed at chemists but at the lay public.) The electrolysis of the ocean water caused hydrogen to form at the cathode. Other cations, such as magnesium, are attracted into the region of the cathode even though they do not plate out. Also, as hydrogen is evolved, the hydroxide concentration in the immediate vacinity of the cathode increases. The increased magnesium concentration and the increased hydroxide concentration become such that the product of their concentrations exceeds the Ksp of magnesium hydroxide; magnesium hydroxide precipitates at the electrode.

In summary, students enjoy being able to relate to their courses. There is a wealth of material available in elementary science magazines in areas other than chemistry. (In reality, we may know a lot of chemistry but are only at an elementary level in many other areas.) Read these articles with the goal to further your own education and to find something that might be of interest to your students. Then find a place for this new information among the countless topics discussed in general chemistry. A minimum of extra time is needed if the new information is made a part of existing example problems.

The results of this effort may be more interesting classes for both you and your students and, in turn, a higher retention of students at your college.